

Introduction to Landform Study

Chapter 13

The Structure of the Earth

- Four Regions
 - The Crust
 - The Mantle
 - The Outer Core
 - The Inner Core

The Crust

- The outermost shell, consists of a broad mixture of rock types
- Average thickness averages 3 miles,
 - Beneath continents the thickness averages more than 5 times that much
- The base of the Crust is a change in mineral composition, called
 - Mohorovicic discontinuity (or Moho)

The Inner and Outer Cores

- The Outer Core
 - Molten and extending to a depth of about 3100 miles
- The Inner Core
 - Solid and very dense mass having a radius of 900 miles
- Both the inner and outer core are made of iron/nickel or iron/silicate.
- Makes up **15% of the Earth's volume** and **32% of its mass**
- The Earth's **magnetic field is generated primarily in the outer core**
- Magnetic field changes over time from North Pole to South Pole

Composition of the Earth

- Minerals
 - Solid
 - Naturally found in nature
 - Inorganic
 - Have a specific chemical composition
 - Contains atoms arranged in a regular pattern to form solid crystals

Kinds of Minerals

- Silicates – composed of silicate minerals, oxygen and silicon
 - Quartz and feldspars are two most common
- Oxides – elements that can combine with oxygen.
 - Iron, particularly hematite, magnetite, and limonite all containing iron
- Sulfides – composed of sulfur in some combination with one or more other elements

- Pyrite, iron and sulfur, galena/ lead,
- **Sulfates** – gypsum that contains sulfur and oxygen, calcium is the main principal combining element.
- **Carbonates** – sedimentary rocks such as limestone (made up of calcium carbonate)
- **Halides** – notably salty, halite or common table salt
- **Native elements** – minerals that occur as discrete elements, gold or silver

Rocks

- Composed of mineral materials – sometimes one mineral, other times many minerals
- Sometimes found at the surface as an “**outcrop**” or below the surface as “**bedrock**” covered with a layer of broken rock called “**regolith**”
- Three main kinds of “**rocks**”
 - **Igneous**
 - **Sedimentary**
 - **Metamorphic**

Igneous Rocks

- **Formed by the cooling and solidification of molten rock** (lava or magma)
- Classification based on **mineral composition and texture**
 - **Plutonic (Intrusive):** Granite, Diorite, Gabbro, Peridotite
 - **Volcanic (Extrusive):** Rhyolite, Andesite, Basalt, Obsidian, Pumice, Tuff

Sedimentary Rocks

- **Created by the combination of pressure and cementation consolidates and transforms sediments**
 - **Clastic (Detrital):** Shale, Sandstone, Conglomerate, Breccia
 - **Chemical and Organic:** Limestone, Travertine, Chert

Metamorphic Rocks

- **Drastically changed by heat and/or pressure – Contact metamorphism and Regional metamorphism**
 - **Foliated:** Slate, Schist, Gneiss
 - **Non-foliated:** Quartzite, Marble, Serpentine

Continental and Ocean Floor Rocks

- **Continental crust consists mostly of granite**
 - **Less dense**
- **Ocean crust consists mostly of basalt**
 - **More dense**
- **Ocean crust is subducted under the continental crust**

Isostasy

- The crust is floating on the denser, deformable mantle below
- Questions:
 - How deep is the sinking of the crust?
 - What determines the real extent of an isostatic adjustment?
 - What is the immediacy of the isostatic response?

The Study of Landforms

- Study of topography– **geomorphology**
 - **Structure** –the nature, arrangement, and orientation of materials making up the feature being studied.
 - **Process**– the actions that have combined to produce the landform
 - **Slope** – the fundamental aspect of shape for any landform
 - **Drainage** – the movement of water (from rainfall to snowmelt), over Earth's surface or down into the soil and bedrock.

To analyze topography answer these questions?

- **What?** The form of the feature or features
- **Where?** The distribution and pattern of the landform assemblage
- **Why?** An explanation of origin and development
- **So what?** The significance of the topography in relationship to other elements of the environment and to human life and activities

Internal Geomorphic Processes

- Crustal rearrangement (plate tectonics)
 - Folding
 - Faulting
 - Uplifting
- Vulcanism
 - Extrusive
 - Intrusive

External Geomorphic Processes

- Weathering
- Mass Wasting
- Erosion/deposition
 - Fluvial (running water)
 - Aeolian (wind)
 - Glacial (moving ice)
 - Solution (ground water)
 - Waves and currents (oceans/lakes)

- Study of these processes Uniformitarianism

Geologic Time

- Earth is about 4.6 billion years old
- Age of the dinosaurs 160 million years ago
- Rocky Mountains uplifted 65 million years ago

Major landforms assemblages of the world

- Flat Plains
- Irregular plains
- Plains with scattered hills/mountains
- Tablelands
- Hills
- Mountains
- Ice caps